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RESEARCH ARTICLE / ARAŞTIRMA MAKALESI

Association of Respiratory Function and Cervical Muscle Strength in Healthy Individuals - A Pilot Study

Sağlıklı Bireylerde Solunum Fonksiyonu ve Servikal Kas Kuvvetinin İlişkisi - Pilot Çalışma

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ABSTRACT

Objective: This study aims to investigate the relationship between respiratory function and cervical muscle strength in healthy individuals.

Material and Methods: A total of 83 individuals (64 females and 19 males, aged 20-25) participated in the study. Respiratory function was assessed with a spirometer using Forced Expiratory Maneuver Test (FFT), with Functional Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV_1), FEV_1/FVC%, Peak Expiratory Flow (PEF), and Forced Expiratory Flow at 25%-75% of the Vital Capacity (FEF_{25-75}) measured and recorded. Neck flexor, right and left lateral flexor, and extensor muscle strengths were evaluated using a hand-held dynamometer.

Results: Moderate-level correlations were observed between FVC and neck muscle strength (r_s = 0.630; r_s = 0.510; r_s = 0.504; r_s = 0.480), as well as between FEV_1 and the strength of neck muscles (r_s = 0.500; r_s = 0.340; r_s = 0.405; r_s = 0.405). Additionally, low-level correlations were noted between PEF and the strength of neck flexor and left lateral flexor muscles (r_s = 0.251; r_s = 0.257), and between $FEF_{25-75\%}$ and the strength of neck flexor, right lateral flexor, and left lateral flexor muscles (r_s = 0.277; r_s = 0.241; r_s = 0.264).

Conclusion: Our findings suggest that cervical muscle strength, particularly that of the neck flexors and extensors, is moderately associated with respiratory function in healthy young adults. This relationship indicates that optimal neck muscle performance may contribute to efficient respiratory mechanics. Further research is needed to clarify the underlying mechanisms and to determine whether cervical muscle strengthening can enhance respiratory performance.

Keywords: Muscle strength, neck muscles, posture, respiratory function tests

ÖZ

Amaç: Bu çalışmanın amacı sağlıklı bireylerde solunum fonksiyonu ile servikal kas kuvveti arasındaki ilişkiyi araştırmaktır.

Gereç ve Yöntem: Çalışmaya toplam 83 birey (64 kadın, 19 erkek; yaşları 20-25 arası) katılmıştır. Solunum fonksiyonu, bir spirometre kullanılarak Zorunlu Ekspiratuvar Manevra Testi (FFT) ile değerlendirilmiş; Fonksiyonel Vital Kapasite (FVC), 1. Saniyedeki Zorlu Ekspiratuvar Hacim (FEV_1), FEV_1/FVC oranı (%), Tepe Ekspiratuvar Akım (PEF) ve Vital Kapasitenin %25-75'inde Zorlu Ekspiratuvar Akım (FEF_{25-75}) ölçülerek kaydedilmiştir. Boyun fleksörleri, sağ ve sol lateral fleksörler ve ekstansör kas kuvvetleri el dinamometresi kullanılarak değerlendirilmiştir.

Bulgular: FVC ile boyun kas kuvveti arasında (r_s = 0.630; r_s = 0.510; r_s = 0.504; r_s = 0.480) ve FEV_1 ile boyun kas kuvveti arasında (r_s = 0.500; r_s = 0.340; r_s = 0.405; r_s = 0.405) orta düzeyde korelasyonlar gözlemlenmiştir. Ayrıca, PEF ile boyun fleksör ve sol lateral fleksör kas kuvveti arasında (r_s = 0.251; r_s = 0.257) ve $FEF_{25-75\%}$ ile boyun fleksör, sağ lateral fleksör ve sol lateral fleksör kas kuvveti arasında (r_s = 0.277; r_s = 0.241; r_s = 0.264) düşük düzeyde korelasyonlar tespit edilmiştir.

Sonuç: Bulgularımız, sağlıklı genç yetişkinlerde servikal kas gücünün, özellikle boyun fleksör ve ekstansör kas kuvvetinin solunum fonksiyonuyla orta düzeyde ilişkili olduğunu göstermektedir. Bu ilişki, optimal boyun kası performansının verimli solunum mekaniğine katkıda bu-

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lunabileceğini göstermektedir. Altta yatan mekanizmaları açıklığa kavuşturmak ve servikal kas güçlendirmenin solunum performansını artırıp artıramayacağını belirlemek için daha fazla araştırmaya ihtiyaç vardır.

Anahtar Sözcükler: Kas kuvveti, boyun kasları, postür, solunum fonksiyon testleri

INTRODUCTION

Normal respiratory mechanics are vital for musculoskeletal health, influencing posture, spinal stability, and overall well-being [1]. Efficient respiration depends on coordinated muscle activity between the diaphragm, intercostal, and accessory muscles of the neck and thorax. While inspiration is primarily active through diaphragmatic contraction, forced breathing recruits muscles such as the external intercostals, scalenes, sternocleidomastoid, and serratus anterior to facilitate thoracic expansion [2-4]. The coordinated function and strength of these muscles are essential for maintaining optimal respiratory capacity.

A stable cervical and thoracic spine is important for an effective respiratory process, allowing rib movement and muscle function [4, 5]. Due to the rising popularity of media devices such as smartphones and computers, frequent users often exhibit incorrect neck posture due to prolonged periods of slouching. This can cause muscle weakness or imbalance in struggle to support the head's weight, leading to the head shifting forward. Forward head posture is frequently associated with various musculoskeletal issues, as it can create significant muscular imbalances and compromise stability between spinal segments [6]. Research suggests these changes often correlate with alterations in thoracic spine positioning and reduced mobility in the thoracic region, these resulting restrictions in rib cage expansion may potentially diminish lung capacity, which could subsequently impair respiratory function [6]. Furthermore, research has shown that based on the close anatomical and biomechanical connections of the cervical and thoracic regions, factors like reduced endurance of deep neck flexors, increased activity and fatigue of superficial neck flexors, limited neck mobility, impaired proprioception, and neuromuscular control disorders can affect respiratory function by hindering rib cage expansion mechanism in those with chronic neck pain [7-11]. Therefore, inspiratory and expiratory strength may be diminished in patients with neck pain.

Correlations have been noted between neck flexor and extensor muscle strength and maximal voluntary ventilation volume, peak expiratory flow rate and vital capacity in individuals with chronic neck pain [12]. In another study conducted on patients with chronic neck pain, it was stated that isometric neck extensor muscle strength is an indicator of respiratory dysfunction and that neck muscle strength is useful in determining respiratory functions [13]. Furthermore, respiratory training has shown promise in enhancing certain cervical musculoskeletal functions and mitigating respiratory disorders [12].

Several biomechanical and clinical studies indicate a functional interplay between cervical posture, neck muscle performance, and respiratory mechanics. The cervical and upper thoracic spines operate as an integrated kinematic unit, so thoracic stiffness or cervical malalignment can alter rib cage mechanics and breathing capacity [7]. Clinical investigations in people with chronic neck pain or forward head posture have reported reduced respiratory muscle performance and lower spirometric values compared with controls, linking altered cervicothoracic curvature and impaired neck muscle strength to diminished respiratory function [8-11, 13]. A systematic review further supports an association between cervical pain/dysfunction and poorer pulmonary function, though the evidence remains heterogeneous and largely correlational [12]. Together, these studies support the mechanistic chain, establishing that forward head posture leads to cervical muscle disorganization, which in turn give way to decline in respiratory parameters, but most evidence derives from symptomatic populations; studies in healthy individuals are scarce. Therefore, the present study examines whether a similar relationship exists in healthy young adults. We hypothesize that greater cervical muscle strength is associated with higher respiratory function parameters.

MATERIAL AND METHODS

Participants

This study was conducted as a cross-sectional observational study, involving 64 females and 19 males aged between 20-25 years. Initially, the study was designed with a statistical power of 95%, a margin of error of 5%, and an effect size of 0.30 (medium), resulting in a required sample size of 138 participants. However, due to challenges in recruiting enough participants to meet this requirement, the statistical power was adjusted to 80%. Using the same margin of error and effect size, the recalculated sample size was reduced to 84 participants. Thus, the study was conducted as an under-powered pilot study. The study was performed in accordance with the Helsinki Declaration (2013), and ethical approval was granted by the Ethics Committee of Health Sciences Institute at Ankara Yıldırım Beyazıt University (23.11.2023/09-434).

Data Collection Process

Participants were briefed about the study, and those who agreed to participate signed an informed consent form. Eligible participants were healthy adults aged 18 years or older who had no pre-existing respiratory illness, musculoskeletal pain, or recent injury affecting the neck or thoracic region. Participants were required to be free of acute illness at the time of testing. Individuals with known respiratory, cardiovascular, neurological, or neuromuscular disorders, chronic neck or back pain, or recent surgery or trauma involving the cervical or thoracic spine were excluded from the study. Visual inspection and functional assessment were also conducted to rule out spinal deformities, postural asymmetries, or mobility limitations that could influence neck muscle strength or respiratory performance. The respiratory function and muscle strength tests were conducted within a single day, averaging an hour per participant. Data for the study was collected at the Department of Physiotherapy and Rehabilitation of Ankara Yıldırım Beyazıt University.

Evaluation of Respiratory Functions

Pulmonary functions were assessed using a Spirometer (MIR, Wisconsin USA), in accordance with the American Thoracic Society (ATS) guidelines [14]. The device was calibrated before testing using a 3-liter calibration syringe following the manufacturer's recommendations to ensure measurement accuracy within the acceptable ±3% error range. In order to ensure hygiene, each participant was provided with a new disposable mouthpiece. Participants were seated with their noses clamped and then instructed to inhale deeply and then exhale quickly and forcefully without pausing. The test concluded with another deep inhalation. The best result from three consecutive attempts was selected. During the test, FVC (forced vital capacity), FEV_1 (forced expiratory volume in 1 second), FEV1% (percentage of forced expiratory volume in 1 second), PEF (Peak flow rate) and $FEF_{25\text{-}75\%}$ of forced expiratory volume 25-75% were recorded. The values measured with the device were compared with the predicted values calculated individually for each participant using the Global Lung Function Initiative (GLI 2012) spirometry reference equations, taking into account age, sex, height, and ethnicity of each participant [15]. To ensure acceptability of the test and to ensure that FEV_1 reflects maximum effort, the extrapolated volume (VEXT) had to be less than 5% of FVC or 150 ml. Results in which VEXT exceeded this limit were not accepted [14, 16].

Evaluation of Neck Muscle Strength

Cervical muscle strength was measured using a handheld dynamometer (Model 01165A, Lafayette Instrument Company, Lafayette, USA), which demonstrates strong reliability and validity in both clinical and healthy populations [17]. Hand-held dynamometry of cervical muscles has shown excellent intra-rater reliability for isometric neck strength with a handheld dynamometer: ICCs ranged from 0.94-0.97 (intra-session) and 0.87-0.95 (inter-session) for multiple directions of neck in neutral alignment (Figure 1). To assess neck flexor strength, the dynamometer was placed against the participant's forehead, and the participant was instructed to resist the applied pressure for 3 seconds without moving the trunk. For neck extensor strength, resistance was applied to the occiput, and for lateral flexor strength, it was applied just above the ear while the head remained in the neutral plane; both right and left sides were tested separately [19]. Each measurement was performed three times, with a 30-second rest between trials, and the and the average values (in Kilogram) was used for statistical analysis. All measurements were conducted by a single licensed physiotherapist with over five years of clinical experience in musculoskeletal assessment.

Figure 1. Cervical muscle strength measurement.

Statistical Analysis

The data from this study were analyzed using the SPSS (Statistical Package for the Social Sciences) version 23. Descriptive statistics such as mean, standard deviation, median, minimum, and maximum were provided for quantitative variables, while frequency (n) and relative frequency (%) were provided for qualitative variables. The Kolmogorov-Smirnov test was used to determine the normality of data distribution. Spearman (r_s) correlation coefficient was used to examine the relationships between PFT measurements and neck muscle strength tests and bootstrap confidence intervals was also calculated. The significance level was set at 0.05. When correlations are statistically significant, their magnitudes are described as weak, moderate, or strong to indicate corresponding effect size. For interpretation: results ranging from 0.9-1.0 indicates a very strong relationship, 0.7-0.89 indicates a strong relationship, 0.4-0.69 indicates a moderate relationship, and 0.2-0.39 indicates a weak relationship [20].

RESULTS

Information on participants' body weight, height, respiratory function test results, and neck muscle strength measurements is shown in Table 1.

Table 1. Details of participants' age, body weight, height, respiratory function test outcomes, and neck muscle strength measurements.

Variables	Mean±SD	Median	Range [Min-Max]
Age (years)	21.37±0.93	21.00	5.00 [20.00 - 25.00]
Weight (kg)	65.21±14.87	63.00	77.00 [38.00 - 115.00]
Height (cm)	167.08±8.74	166.00	45.00 [150.00 - 195.00]
PFT Measurements			
FEV_1_M	3.56±0.76	3.46	3.83 [1.61 - 5.44]
FEV_1_P	3.62±0.57	3.44	2.49 [2.80 - 5.29]
FVC_M	4.17±0.87	3.97	4.21 [2.50 - 6.71]
FVC_P	4.16±0.76	3.87	3.43 [3.21 - 6.64]
$FEV_{1\%}$_M	84.79±9.34	86.60	53.30 [46.70 - 100.00]
$FEV_{1\%}$_P	84.71±0.74	85.10	3.20 [83.10 - 86.30]
PEF_M	6.17±2.00	6.03	9.78 [1.92 - 11.70]
PEF_P	7.81±1.24	7.31	5.64 [5.58 - 11.22]
$FEF_{25-75\%}$_M	4.03±1.11	4.06	5.70 [1.00 - 6.70]
$FEF_{25-75\%}$_P	4.46±0.42	4.27	1.51 [4.07 - 5.58]
Neck Muscle Strength			
Flexion	9.36±3.80	8.07	16.29 [5.33 -21.62]
Right lateral flexion	10.37±4.46	8.50	17.47 [5.63 - 23.10]
Left lateral flexion	10.17±4.06	8.73	16.56 [5.27 - 21.83]
Extension	12.41±4.96	10.97	21.04 [5.33 - 26.37]

Mean±SD: Mean±Standard Deviation, M: Measured value, P: Predicted value, Min-Max: Minimum-Maximum, kg: kilogram, cm: centimeter, PFT: pulmonary function test, FEV: forced expiratory volume, FVC: forced vital capacity, PEF: peak expiratory flow, FEF: forced expiratory flow.

The relationships between pulmonary function test (PFT) measurements and neck muscle strength are summarized in Table 2.

A positive, significant, and moderate correlation was found between measured FEV_1 and the strength of the neck flexor, right lateral flexor, and left lateral flexor muscles (r_s = 0.500, r_s = 0.405, r_s= 0.405, respectively). Additionally, a positive, significant, but low correlation was observed between measured FEV_1 and the strength of the neck extensor muscle (r_s = 0.343). For predicted FEV_1, a positive, significant, and moderate correlation was identified with neck flexor, right lateral flexor, left lateral flexor, and extensor muscle strength (r_s = 0.606, r_s = 0.543, r_s = 0.531, r_s = 0.477, respectively) (Table 2).

Table 2. Analysis of the correlations between pulmonary function test measurements and neck muscle strength.

PFT		Neck Muscle Strength			
		Flexion	Right lateral flexion	Left lateral flexion	Extension
FEV_1_M	Coefficient*	**0.500**	**0.405**	**0.405**	**0.343**
	p	<0.001	<0.001	<0.001	0.001
	95% C.I.	[0.289; 0.663]	[0.184; 0.573]	[0.184; 0.586]	[0.121; 0.540]
FEV_1_P	Coefficient*	**0.606**	**0.543**	**0.531**	**0.477**
	p	<0.001	<0.001	<0.001	<0.001
	95% C.I.	[0.416; 0.732]	[0.346; 0.683]	[0.339; 0.663]	[0.259; 0.643]
FVC_M	Coefficient*	**0.630**	**0.510**	**0.504**	**0.480**
	p	<0.001	<0.001	<0.001	<0.001
	95% C.I.	[0.447; 0.759]	[0.317; 0.666]	[0.317; 0.659]	[0.247; 0.647]
FVC_P	Coefficient*	**0.621**	**0.565**	**0.560**	**0.505**
	p	<0.001	<0.001	<0.001	<0.001
	95% C.I.	[0.432; 0.743]	[0.354; 0.705]	[0.353; 0.703]	[0.302; 0.663]
PEF_M	Coefficient*	**0.251**	0.180	**0.257**	0.169
	p	0.022	0.103	0.019	0.127
	95% C.I.	[0.017; 0.453]	[-0.075; 0.398]	[0.021; 0.469]	[-0.063; 0.404]
PEF_P	Coefficient*	**0.562**	**0.515**	**0.509**	**0.458**
	p	<0.001	<0.001	<0.001	<0.001
	95% C.I.	[0.352; 0.714]	[0.315; 0.674]	[0.308; 0.673]	[0.243; 0.629]
$FEF_{25\text{-}75\%}$_M	Coefficient*	**0.277**	**0.241**	**0.264**	0.181
	p	0.011	0.028	0.016	0.102
	95% C.I.	[0.048; 0.478]	[0.010; 0.444]	[0.051; 0.468]	[-0.056; 0.397]
$FEF_{25\text{-}75\%}$_P	Coefficient*	**0.544**	**0.492**	**0.492**	**0.429**
	p	<0.001	<0.001	<0.001	<0.001
	95% C.I.	[0.347; 0.691]	[0.277; 0.643]	[0.290; 0.651]	[0.202; 0.592]

**Spearman rank numbers correlation coefficient result (r_s). C.I: Bootstrap confidence interval, M: Measured value, P: Predicted value, PFT: pulmonary function test, FEV: forced expiratory volume, FVC: forced vital capacity, PEF: peak expiratory flow, FEF: forced expiratory flow.*

A positive, significant, and moderate correlation was also observed between measured FVC and neck flexor, right lateral flexor, left lateral flexor, and neck extensor muscle strength (r_s = 0.630, r_s = 0.510, r_s = 0.504, r_s = 0.480, respectively). Similarly, predicted FVC showed a positive, significant, and moderate correlation with strength of neck flexor, right lateral flexor, left lateral flexor, and extensor muscles (r_s = 0.621, r_s = 0.565, r_s = 0.560, r_s = 0.505, respectively) (Table 2).

For measured PEF, a positive, significant, but low-level correlation was found with the strength of the flexor (r_s= 0.251) and left lateral flexor muscles (r_s = 0.257). No significant correlation was observed between measured PEF and the strength of the right lateral flexor (P = 0.103) or extensor muscle (P = 0.127). Predicted PEF, however, showed a positive, significant, and moderate correlation with neck flexor, right lateral flexor, left lateral flexor, and extensor muscle strength (r_s = 0.562, r_s = 0.515, r_s = 0.509, r_s = 0.458, respectively) (Table 2).

Measured FEF_{25-75} exhibited a positive, significant, but low-level correlation with the flexor, right lateral flexor, and left lateral flexor muscles (r_s = 0.277, r_s = 0.241, r_s = 0.264, respectively). No significant correlation was found between measured FEF_{25-75} and extensor muscle strength (P = 0.102). Predicted FEF_{25-75} demonstrated a positive, significant, and moderate correlation with flexor, right lateral flexor, left lateral flexor, and extensor muscle strength (r_s = 0.544, r_s = 0.492, r_s = 0.492, r_s = 0.429, respectively) (Table 2).

DISCUSSION

Our study, aimed at investigating the association between respiratory function and cervical muscle strength in healthy individuals, found that an increase in the strength of the neck flexor, extensor, right lateral flexor, and left lateral flexor muscles is associated with higher measured and predicted values of FEV_1, FVC, PEF, and FEF_{25-75}.

Our findings indicate a positive, significant, and moderate correlation between measured FEV_1 and neck flexor, extensor, and lateral flexor muscle strength. FEV_1 reflects expiratory airflow efficiency, which depends on the coordination and strength of the thoracic and accessory respiratory muscles. The neck muscles, especially the scalenus and sternocleidomastoids, serve as accessory muscles during forced expiration [21]. Their activation during increased respiratory effort may explain the measured correlation, as stronger neck muscles may support better respiratory mechanics [22]. This suggests a possible feedback mechanism whereby improved neck muscle strength may improve respiratory performance, particularly in populations with impaired respiratory function. Similarly, a positive, significant, and moderate correlation was observed between measured FVC and overall neck muscle strength. FVC measures the maximum volume of air exhaled after a full inhalation, an effort influenced by both inspiratory and expiratory muscle capacity. The engagement of the neck muscles at maximum respiratory efforts further emphasizes the interaction between respiratory function and cervical musculature. This relationship is particularly important for rehabilitation programs targeting respiratory endurance and postural stability [23].

Our findings align with emerging evidence linking postural deviations, particularly forward head posture, with impaired respiratory function. Meta-analytic data suggest that individuals with forward head posture demonstrate reduced diaphragm excursion and lower activation of primary inspiratory muscles, accompanied by compensatory overactivity of accessory respiratory muscles [24]. These adaptations are believed to alter rib cage kinematics and thoracic expansion, resulting in decreased FVC and FEV_1 values. Although our study did not directly assess postural parameters, the moderate associations observed between cervical muscle strength and respiratory indices support the hypothesis that optimal neck muscle performance contributes to efficient respiratory mechanics. These findings are consistent with previous work emphasizing the interdependence of cervical stability, posture, and respiratory efficiency in both healthy and clinical populations.

Our results also show a positive, significant and low-level correlation between measured PEF and the strength of the neck flexors and left lateral flexors. However, no significant correlation was found for the right lateral flexors and extensors. PEF represents the maximum flow generated during forced expiration and is influenced by factors such as airway caliber and expiratory muscle strength. The observed asymmetry in correlations may point toward potential lateral dominance or differences in muscle recruitment patterns during expiration, although this remains speculative. These preliminary findings raise the possibility that certain neck muscles may contribute to expiratory force; however, their influence on peak flow appears to be less prominent than that of muscles more directly involved in thoracic mechanics [25]. The measured $FEF_{25-75\%}$ showed a positive, significant and low-level correlation with the flexors and lateral flexors, but not with the extensors. $FEF_{25-75\%}$ primarily assesses small airway function, which is less dependent on muscle effort compared to FEV_1 or FVC. The weaker correlations observed in this study may indicate a limited association between neck muscle strength and small airway dynamics. This aligns with the notion that small airway function is more closely related to factors such as airway resistance and compliance rather than muscular contribution, though further investigation is needed to clarify these relationships [26]. The asymmetry observed between PEF and lateral flexor strength, particularly between sides, may reflect lateralized neuromuscular control influenced by factors such as functional dominance or postural habits, ance and muscle strength distribution [27]. While previous studies suggest side-specific differences especially in cervical muscle recruitment, we did not assess hand or limb dominance, which may have influenced our findings.

We could not find any isolated studies in healthy subjects investigating the relationship between neck muscle strength and respiratory function. However, in line with our findings, a study in patients with Myasthenia Gravis reported that FVC showed a significant correlation with neck flexor muscle strength [28]. In contrast, this correlation was not determined in another study in patients with Guillain-Barré Syndrome [29].

Chronic neck pain has been associated with cervical muscle strength because consistent pain leads to muscle imbalance, altered chest mechanics and reduced respiratory muscle strength [30, 31]. Several studies comparing individuals with chronic neck pain to healthy controls showed consistent statistically significant differences in pulmonary function, particularly in FEV_1 and FVC, while findings for $FEF_{25\text{-}75\%}$, FEV_1/FVC, and PEF were more variable, with these parameters often showing no significant differences between groups [10, 32, 33]. While comparisons with chronic neck pain studies offer insight, because chronic neck dysfunction may impair respiration by causing overactivation and early fatigue of accessory respiratory muscles such as the sternocleidomastoid, scalene, and upper trapezius. This compensatory pattern can reduce ventilatory efficiency and overall respiratory capacity. Previous studies suggest that altered neuromuscular coordination and weakened deep cervical flexors contribute to this imbalance [34]. We urge caution, as similarities observed may reflect shared biomechanical pathways rather than identical physiological mechanisms. Our study provides preliminary evidence that supports these connections in a healthy cohort, but future studies directly comparing both populations under standardized conditions are needed to clarify these relationships.

Our study has several limitations. First, it does not comprehensively address potential confounding factors such as participants' physical activity level or smoking status, as these may affect neck muscle strength and respiratory performance. Another limitation of this study is the demographic homogeneity of the sample, with females comprising the majority of participants. This limitation may reduce the external validity of the findings and their applicability to broader populations. Also, the limited availability of existing data on cervical muscle strength and respiratory function in healthy individuals presents an additional challenge, making it difficult to draw definitive conclusions or establish foundational correlations. In addition, due to the limited sample size and unequal group distribution, only bivariate correlations were performed instead of partial correlation or multivariate regression analyses. However, as a pilot study and potentially one of the first to explore this relationship in a healthy population, our findings provide valuable preliminary insights and a basis for future research with more diverse and representative samples. We recommend that future studies investigate the effects of targeted neck muscle training on respiratory outcomes to provide new insights into rehabilitation methods. Furthermore, the asymmetry observed in PEF correlations warrants further investigation into lateralized muscle involvement and its effects on respiratory and postural health.

CONCLUSION

Our study suggests that increased neck muscle strength in healthy individuals is associated with improved respiratory function. While this study identified moderate correlations between cervical muscle strength and several spirometric parameters, the magnitude of these relationships should be interpreted cautiously in terms of clinical significance. We recommend incorporating exercises to maintain or enhance respiratory function into rehabilitation programs for neck-related issues. Similarly, exercises aimed at preserving or improving neck muscle strength should be included in rehabilitation programs for respiratory-related conditions.

Ethics Committee Approval / Etik Komite Onayı
The approval for this study was obtained from Institute of Health Sciences Clinical Research Ethics Committee, Ankara Yıldırım Beyazıt University, Türkiye (Decision no: 09-434, Date: 23/11/2023).

Conflict of Interest / Çıkar Çatışması
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Author Contributions / Yazar Katkıları
Conception – BA; Design – BA, SK, TK; Supervision – BA, TK; Materials – BA, SUS, TK; Data Collection – BA, SK, SUS; Analysis – BA, AEY; Literature Review – BA, SK, SUS, TK; Writing – BA, SK, SUS; Review – BA, SUS, AEY, TK. All authors contributed to the final version of the manuscript and discussed the results and contributed to the final manuscript.

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